WFIRST SDT Meeting

Telescope Status

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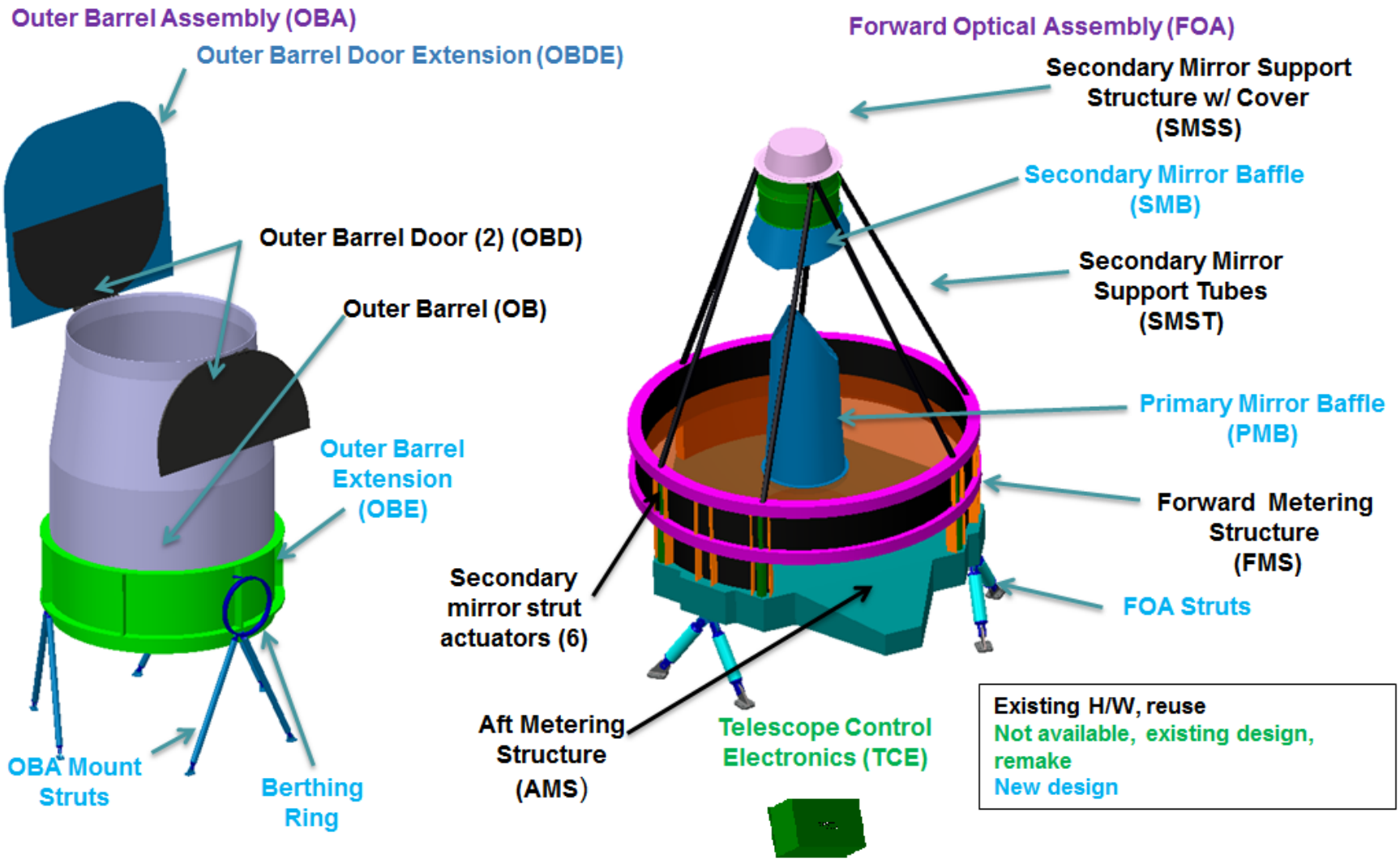
Telescope Overview

- Two, 2.4 m, two-mirror telescopes provided to NASA. Built by ITT/Exelis
  - Ultra Low Expansion (ULE®) glass mirrors
  - low-CTE precision composite structure
  - Secondary mirror actuators provide 6 degree of freedom control
  - Additional secondary mirror fine focus actuator
  - Active thermal control of structure
  - Designed for operation at room temperature (293 K) with survival temperature of 277 K
  - Outer barrel includes recloseable door
  - Passive damping at the spacecraft interface
- Some telescope modifications are required, but focus is on minimizing telescope cost/risk

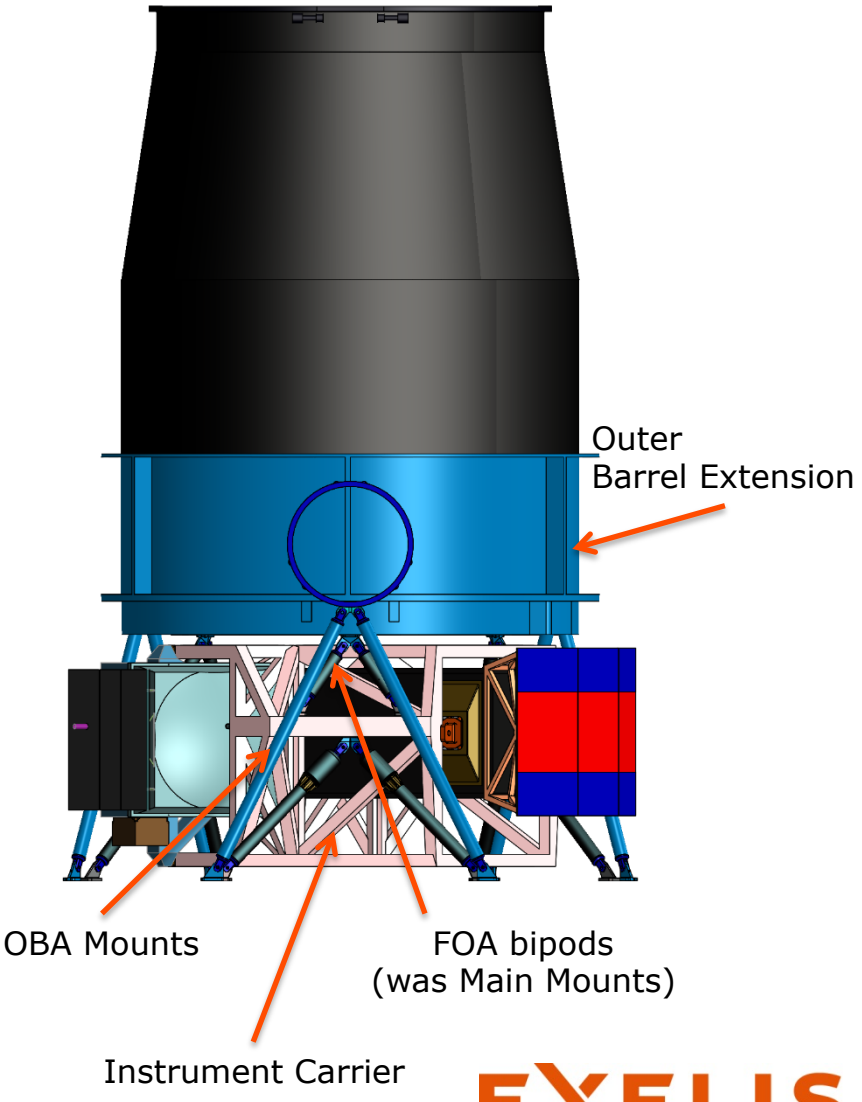
Telescope Reuse/Remake/New design



100% of the existing telescope hardware is being re-used. Electronics and baffles not available and must be replaced.

Telescope Additions/Modifications

- Latest additions/modifications required for WFIRST:
  - FOA Bipods replace Main Mounts
    - Shorter, metering structure, attach to Instrument Carrier
  - OBA Mount
    - length change to accommodate Instrument Carrier
  - Telescope Operating Temperature Baseline 282K
    - within qualified temperature range
  - No instrument loads on Telescope.
    - Instruments and Telescope all interface at a Instrument Carrier structure.



Accomplishments since last SDT Meeting

- Cycle-5 Telescope design complete
  - Changes include:
    - Shorter FOA bipods that replace the Main Mounts
    - Longer OBA bipods
    - Updated thermal control system that reflects the new heater electronics paradigm
    - Heater control electronics based on existing proportional heater boards used on other current flight projects
  - Finite Element Models have been updated with temperature dependent material properties and will be used to assess lower operating temperatures
- Isothermal soak analysis of Foreward Optic Assembly at 282K and 250K.
- Updated Master Equipment List

Operating Temperature Related Activity Results (1 of 2)

- Cold Test of 1/3 Dev Models (FY13)
  - Developmental models thermal cycled from room temp down to 235K.
  - Non-destructive testing done before and after.
  - Acoustic monitoring.
  - No apparent damage to the composite structures.
- CTE Testing of existing laminate coupons (FY14)
  - Room temperature testing revealed no change since last tested ~10 years ago.
  - CTE measurements of laminates down to 235K show the CTE values remain within original design specifications at room temperature.
- Mechanical testing of laminate shear strength after thermal cycling (FY14)
  - Tested strength within original design specifications at room temperature.

Operating Temperature Related Activity Results (2 of 2)

- Isothermal soak analysis of FOA with temperature dependent finite element model (FY14).
  - Modeling results showed change to PM and SM surface figures to be:
    - PM surface figure change with Best Fit Plane & Power subtracted

      3.4 nm rms at 280K

      11.5 nm rms at 250K
    - SM suface figure change with Best Fit Plane & Power subtracted

      2.2 nm rms @ 280K

      7.2 nm rms @ 250K

Telescope Status

- Large Optic Metrology Testbed of High Dynamic Range Wavefront Sensing has been *cancelled*
  - Other JPL sponsor reprioritized funding
  - $5M total cost too much for WFIRST/AFTA to fund in the current budget environment

- Cool Test of Unit#2 (Center of Curvature change in optical performance measurement) has been *deferred* to late FY15 or FY16
  - It was found that a thermal management and control system that leveraged the existing flight heaters on the FOA, in addition to a planned external heat exchanger, are required to provide sufficient thermal stability for the Cool Test metrology system.
  - This requires control electronics suitable for flight hardware, as well as flight testing rigor.
  - Reprioritized fabrication of composite laminate coupons for testing and continuing to perform analysis to assess whether additional temperature margin is available for the telescope hardware.

Planned FY15 Activities

- Telescope Cycle-5 STOP analysis
- Telescope STOP analysis with 270K and 250K operating temperature
- Planning Primary Mirror and Secondary Mirror re-work and verification
- Full Telescope Assembly, Integration and Test Verification and Validation planning for Phase B/C/D
- Aging assessment of all existing hardware
- Fabricate composite laminate coupons
- Document Configuration and Data Management
  - Compile all relevant documentation from the previous program into a single, non-classified database
  - Required for full compilation of the full pedigree of all existing hardware